

U.S. Patent Application Serial No. 10/019,287
Amendment filed November 14, 2005
Reply to OA dated June 15, 2005

REMARKS

In the present amendment, previously withdrawn claims 1-5, 12-18 and 31-33 have been canceled without prejudice or disclaimer, and claims 11, 19, 20, 30, 34, 44, 45, 64, 65, 76, 86, and 87 have been amended. Upon entry of this amendment, claims 6-11, 19-30 and 34-88 will be pending.

No new matter has been introduced by this Amendment. Entry and consideration of this Amendment are respectfully requested.

Claims 11 and 30 have been amended to delete an occurrence of "the", which was inadvertently not deleted in the last amendment. This represents only a correction of a typographic error.

Support for the amendments to claims 19, 20, 34, 44, 45, 64, 65, 76, 86, and 87, is discussed below.

The rejection of Claims 6-11, 19-30, and 34-88 under 35 U.S.C. 103(a) as being unpatentable over Fukuda et al (U.S. 5,185,092) in view of Satoru et al (JP-07-233385) and Hiroyasu (JP-10-140170) has been maintained for the reasons of the record on 10/7/04. (page 3 of the Office action)

The rejection of claims 6-11 is respectfully traversed. The rejection of claims 19-30 and 34-88 is overcome by the amendments to the claims.

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In the amendment to claims 19, 20, 34, 44, 45, 64, 65, 76, 86, and 87, the recitation that the dicarboxylic acid mixed diester can be aromatic has been deleted, and correspondingly, the recitation that "A" can represent a benzene ring is also deleted. This represents only a narrowing of the claims to the previously recited alicyclic species. Claims 6-11 are already limited to the process for preparing the alicyclic dicarboxylic acid.

Summary of the Cited References

Fukuda discloses a lubricating oil containing a diester of an **aliphatic dicarboxylic acid** with an aliphatic monohydric alcohol and a diester of an aromatic dicarboxylic acid with an aliphatic monohydric alcohol (column 3, etc.). Fukuda further discloses an esterification reaction in the presence of an acid catalyst such as phosphoric acid (column 6, lines 35-38) along with a purification step using silica gel, etc.

Satoru discloses polyol esters, polyvalent carboxylates, fumarate oligomers and the like (paragraph [0013]), and discloses that polyvalent carboxylates are prepared by esterification of polyvalent carboxylic acids (e.g. aliphatic polyvalent carboxylic acids such as 1,2,3,4-butanetetracarboxylic acids and alicyclic polyvalent carboxylic acids such as 1,4-cyclohexanecarboxylic acid) with monohydric alcohols (paragraph [0020]). Paragraph [0037] discloses that phosphoric acid can be used as an esterification acid catalyst. Paragraph [0039] discloses that the polyol esters, fumarate oligomers, etc., are neutralized using potassium hydroxide, etc., in the purification process. Paragraph [0040] discloses that purification of the ester is conducted

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using silica gel, etc.

Hiroyasu discloses an ester obtained from a monohydric alcohol and an aromatic tribasic acid or anhydride thereof (Claim 1, etc.). Paragraph [0028] discloses an esterification reaction between 2-methylpropanol and trimellitic anhydride in the absence of a catalyst.

Arguments against the rejection

(a) On page 5, lines 5-7, of the Office Action, the Examiner states: "Fukuda et al does teach the preparation of the lubricating oil for a refrigerator in which the base oil is a diester of an aliphatic monohydric alcohol and a **generic aliphatic dicarboxylic acid** (see col. 2, line 16-27), which includes cyclohexanedicarboxylic acid or methylcyclohexanedicarboxylic acid" (emphasis added).

However, Applicant first notes that Fukuda uses the term "aliphatic dicarboxylic acid", but does not use the term "generic"; the Examiner has added this term. Fukuda uses the term "aliphatic dicarboxylic acid" without explicit definition, except for the examples given in column 5, lines 38-45. Applicant submits that the term "aliphatic", as used in the art, signifies an "**open-chain**" or "**straight chain**" structure, as shown in McGraw-Hill Dictionary of Scientific and Technical Terms, Third Edition, page 50, and Webster's Third New International Dictionary, p. 53. Kirk-Othmer Encyclopedia of Chemical Technology, Fourth Edition, vol. 8, pp. 118-120, also indicates that "aliphatic dicarboxylic acid" means a straight-chain or branched-chain dicarboxylic acid. (These documents are made of record in the accompanying IDS). That is, "**aliphatic**" is clearly distinct from "**alicyclic**", according to standard dictionary definitions.

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Moreover, Fukuda lists specific examples of the aliphatic dicarboxylic acids in column 5, lines 5-12 and 38-48, and **no alicyclic compound** is included in this list.

Accordingly, contrary to the Examiner's assertion, the term "aliphatic dicarboxylic acid" as used in Fukuda **does not encompass "alicyclic dicarboxylic acids"**, such as cyclohexanedicarboxylic acid or methylcyclohexanedicarboxylic acid. That is, there is no disclosure of, or suggestion for, "alicyclic dicarboxylic acids" in Fukuda.

The Examiner states the rejection as incorporating "Hiroyasu's aromatic aldehyde as the reactant as an alternative in the absence of catalyst along with the addition of Satoru's et al neutralization step after esterification, into Fukuda et al process" (Office action, page 8, lines 4-6). Since the rejection appears to be based on the modification of Fukuda's process, but Fukuda lacks the basic requirement of the present claims of an "alicyclic dicarboxylic acid," Applicant submits that the Examiner has not made a proper *prima facie* case of obviousness.

(b) On page 5, lines 8-9, of the Office Action, the Examiner states that Fukuda teaches "[a diester] of aliphatic monohydric alcohol and an aromatic di or -tri carboxylic acid (see col. 3, lines 12-14)".

However, there is no such disclosure in column 3, lines 12-14, of Fukuda. It is unclear to which portion of Fukuda this refers.

Moreover, as noted above, claims 6-11 did not previously encompass an ester of an "aromatic di- or tri-carboxylic acid", and claims 19-30 and 34-88 have been amended to delete the recitation

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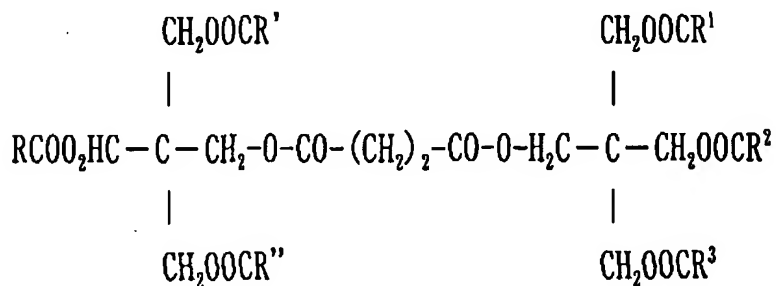
of an aromatic dicarboxylic acid. This portion of the Examiner's argument is therefore moot.

(c) In the Office Action, page 5, lines 9 to the final line, the Examiner states "it [is?] possible to form the mixture of the esters as shown below (see [Fukuda] col. 5, lines 16-34):

"The mixing ratio of the aliphatic monocarboxylic acid and the aliphatic acid or aromatic dicarboxylic acid, aromatic tricarboxylic acid or aromatic tetracarboxylic acid is preferably 6:1 (mol ratio). In the esterification reaction, the ratio of the total quantity of aliphatic monocarboxylic acid and aliphatic dicarboxylic acid or aromatic dicarboxylic acid to the quantity of aliphatic polyhydric alcohol is preferably 7:1 (mol ratio).

For the esterification reaction, the lubricating oil for a refrigerator of this invention may be prepared through the reaction of a partially esterified substance with an aliphatic monocarboxylic acid after the esterified substance is obtained by the reaction of the polyhydric alcohol with the aliphatic dicarboxylic acids may be reversed. Or, mixed carboxylic acids may be used for the esterification."

However, the quoted lines of Fukuda relate to complex esters of a **polyol** with a **mixed acid (aliphatic acid and dibasic acid)** (column. 4, lines 47-51). As a specific example thereof, Example 6 of Fukuda provides a complex ester of the following structure:



As is clear from this chemical formula, the ester given in Fukuda, column 5, lines 16-34, is classified as a so-called **polyol ester**.

On the other hand, esters of the present invention are **alicyclic dicarboxylic acid esters (so-called alicyclic dibasic acid diesters) of monohydric alcohols and alicyclic dicarboxylic acids**, etc., which are completely different from Fukuda's esters. Furthermore, in the technical field of lubricating oils, these two kinds of esters are clearly distinguished and classified into different categories. Therefore, there is no motivation in Fukuda to use an alicyclic dicarboxylic acid ester, which is required in the present invention.

Further, the preparation process of present claims 19-30 and 34-88 is characterized by reacting an alicyclic dicarboxylic anhydride with alcohol component 1 (monoesterification; step 1) and then with alcohol component 2 (diesterification; step 2), and alicyclic adjacent dicarboxylic acid mixed esters which result from such a two-step process have excellent hydrolytic stability, heat stability, volume resistivity and like properties.

Fukuda describes in column 5, lines 25-34, that (A) an ester may be prepared through the reaction of a partially esterified substance with an aliphatic acid after the esterified substance is obtained by the reaction of a polyol with a dibasic acid, or the order of reaction of the acids may be reversed; or alternatively, (B) mixed carboxylic acids may be used for the esterification. In other words, either a one-step process or a two-step process can be employed.

In contrast, the process of the present invention is such that an alicyclic dicarboxylic

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anhydride is reacted with a monohydric alcohol in a two-step process, which offers remarkable advantages over a one-step process.

This may be seen in examples in the present specification. In Example II-1 of the present invention, which employs a two-step process (monoesterification prior to diesterification), the completion of the reaction to convert an alicyclic dicarboxylic anhydride into a mixed diester takes 1 hour at 130 °C (first step) and further 7 hours at 220 °C (second step) to complete. In contrast, in Comparative Example II-2 which employs a one-step process (direct diesterification), the reaction takes 26 hours at 210 °C.

The ester of Comparative Example II-2 obtained by a one-step process exhibits lower hydrolytic stability, heat stability and volume resistivity, compared to that of Example II-1 (see the specification, Table 7). This indicates that the process of the present invention (Claims 19-30 and 34-88), because a two-step process is employed therein, provides a remarkable effect that is **unexpected** based on the teachings of Fukuda or the other cited references.

(d) In the Office Action, page 6, lines 2-4, with a quotation from column 6, lines 35-65, of Fukuda, the Examiner states that Fukuda teaches that the esterification reaction provides esters having a peroxide number below 1.0 meq/kg.

Fukuda states:

"Esters can be obtained by the esterification reaction, e.g., by esterification of alcohols and aliphatic carboxylic acid in the presence of a acid catalyst, e.g., phosphoric acid (col. 6, lines 35-37).

and

Further, to increase the refrigerant stability, it is necessary to reduce the peroxide number, aldehyde number and bromine number to lower values. ...

For this purpose, it is necessary to purify the above esters obtained by the normal esterification reaction and to adjust the above indices for the properties of the ester oil to a range suitable for an oil for a refrigerator. As a result, an excellent oil for refrigerator can be prepared.

It is preferable to purify organic carboxylic acid esters through contact processing with silica gel, activated alumina, activated carbon, zeolite, etc." (col.6, lines 52-65)

Specifically, Example 10 of Fukuda discloses the following: The specimen oils 35, 36 and 37 are obtained by esterification reaction and contact processing by a zeolite. These specimen oils all have a peroxide number of 1.0 meq/kg or less, specifically, of 0.1, 0.3 and 0.6, respectively. Meanwhile, specimen oils 40 and 41, which were not zeolite-processed, have a peroxide number of 1.0 meq/kg or more, i.e., 1.5 and 2, respectively. In other words, Fukuda discloses that when both esterification reaction and contact processing by a zeolite are carried out, the peroxide number of the obtained ester is 1.0 meq/kg or less.

However, as explained in (a) and (c) above, Fukuda's ester is **not** the alicyclic dicarboxylic acid ester of the present invention. If the esterification and adsorbent-processing (processing by activated carbon, zeolite and the like) according to Fukuda's method were applied to the alicyclic compounds in the present invention, the peroxide number of the obtained product would not necessarily be below 1.0 meq/kg. Even when the neutralizing and washing with water steps disclosed in Satoru are further employed in addition to the esterification and adsorbent-processing, esters having a peroxide number of 10 meq/kg or less cannot be obtained.

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This can be seen from Comparative Examples I-3 and II-2 of the specification. Specifically, in Comparative Example I-3, although esterification reaction is conducted in the presence of a **phosphoric acid catalyst**, followed by **neutralization, washing with water**, and purification with **activated carbon**, the thereby obtained ester has a peroxide number of 1.3 meq/kg, which exceeds 1.0 meq/kg.

In Comparative Example II-2, **one-step esterification** using **tetraisopropyl titanate** is performed, followed by **neutralization, washing with water**, and purification with **activated carbon**. The thereby obtained ester has a peroxide number of 1.3 meq/kg, which exceeds 1.0 meq/kg.

That is to say, a mere combination of Fukuda (esterification and adsorbent-processing) and Satoru (esterification, neutralization, water-washing and adsorbent-processing) cannot provide the desired alicyclic dicarboxylic acid ester of the present invention, whose peroxide value is 10 meq/kg or less.

In contrast, claims 6-11 (corresponding to embodiment I) and claims 19-30 and 34-88 (corresponding to embodiment II) of the present invention use the conditions described below in addition to esterification and purification processes disclosed in Fukuda and Satoru, and thereby provide an ester having a desired peroxide value.

[Embodiment I] (Claims 6-11), **in the absence of a catalyst or in the presence of a sulfur-free and phosphorus-free catalyst**, uses as a starting material an alcohol having a **restricted**

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peroxide value, and thereby gives a desired alicyclic dicarboxylic acid diester.

[Embodiment II] (Claims 19-30 and 34-88), **in the absence of a catalyst or in the presence of a sulfur-free and phosphorus-free catalyst**, employs a **2-step esterification process**, and thereby gives a desired alicyclic dicarboxylic mixed diester.

In addition, due to these conditions, the thus-obtained diesters are provided with excellent characteristics as a lubricating oil, having all the properties 1) to 9) recited in the claims. These remarkable effects cannot be expected from Fukuda and/or Satoru.

(e) In the Office Action, page 6, fifth line from the bottom and following, the Examiner states that although Fukuda is silent with respect to the sulfur and phosphorus contents of 20 ppm, it would have been obvious for those skilled in the art to carry out the sulfur and phosphorous content test so as to assess the lubricating oil.

However, Fukuda nowhere describes or suggests the significance of testing a lubricating oil for its sulfur and phosphorous content, or the necessity of restricting these contents to 20 ppm or less. The Examiner does not cite any document suggesting restricting these contents to the recited levels.

Moreover, Applicant submits that it is unreasonable to conclude that the reduction of the content to 20 ppm or lower would be easily practiced by a skilled artisan, even if there were a suggestion to lower these values. The Examiner has not cited any reference disclosing a method for achieving the claimed limitations.

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(f) The Examiner asserts on page 7, lines 11-12, of the Office Action that Hiroyasu discloses the formation of a triester by esterifying a monohydric alcohol with an aromatic tribasic acid in the absence of a catalyst, and on page 8, lines 3-5, the Examiner combines Hiroyasu's aromatic anhydride with Fukuda's process.

However, as discussed above, the present invention is an **alicyclic dicarboxylic acid diester**, and aromatic dicarboxylic acid diesters are not encompassed therein. That is, the ester of the invention is clearly different from Hiroyasu's aromatic tribasic acid-derived ester in chemical structure. Thus, there is no motivation in Hiroyasu to modify Fukuda as suggested by the Examiner.

(g) As described above, what is disclosed in the primary Fukuda reference is an ester whose chemical structure is completely different from that of the present invention, and there thus is no motivation therein to arrive at the present invention. No combination of Fukuda and Satoru cannot lead to the present invention, and Applicant submits that no *prima facie* case of obviousness can be made using the cited references. Moreover, the ester of the invention achieves remarkable effects which cannot be expected from the references, as explained in (c) and (d) above. Accordingly, Claims 6-11, 19-30 and 34-88 are not obvious over Fukuda et al. (U.S. 5,185,092), Satoru et al. (JP-07-233385), and Hiroyasu (JP-10-140170), taken separately or in combination. Reconsideration of the rejection is respectfully requested.

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In view of the aforementioned amendments and accompanying remarks, the claims, as amended, are in condition for allowance, which action, at an early date, is requested.

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact Applicant's undersigned agent at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, Applicant respectfully petitions for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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Enclosures: Request for Continued Examination (RCE)
Petition for a two-month Extension of Time
Information Disclosure Statement
PTO-1449 Form with 7 references and Supplemental EPO Search Report